



DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
WATER QUALITY MONITORING AND ASSESSMENT SECTION
WATERSHED INFORMATION SHEET

Upper Grand River Basin-10280101

Basin Description

The upstream most portions of the Grand River basin lie in southern Iowa. The East, Middle and West Forks meet just south of Albany and form the Grand River. The upper portion of the basin within Missouri extends from the Iowa state line to the confluence with Shoal Creek near Chillicothe. The Missouri portion of the basin has an area of 2,811 square miles. The major tributaries include the East, Middle and West forks of the Grand and Big, Lost and Shoal Creeks. The largest reservoir in the basin is Lake Viking with a surface area of 550 acres. Reservoirs are an important source of drinking water in this portion of the state. There are 18 reservoirs that serve public drinking water supply sources in this basin.

Average annual rainfall ranges from 36 inches in the northwestern part of the basin to 38 inches in the southeastern portion. Stream flow statistics for the basin are shown in Table 1.

Table 1. Stream Flow Statistics for Upper Grand River Basin

Stream/Location	Wtrshd. Area (sq.mi.)	Period Of Record	Flow (cfs)				
			90 th Percentile *	Mean	Median **	10 th Percentile ***	7Q10 Low Flow+
E. Fk. Big Cr. nr. Bethany	95	1934-72 1996-2004	88	49.4	3.9	0.0	
Grand R. nr. Gallatin	2,250	1921-2004	2,510	1,233	211	26	4.0
Grand R. nr. Stanberry		1943-47 1962-70					1.0
M. Fk. Grand R. nr. Albany		1962-70					0.1

* Flow is less than this amount 90 percent of the time

**Flow is less than this amount 50 percent of the time

***Flow is less than this amount 10 percent of the time

+ The lowest average seven consecutive day flow that occurs with a recurrence interval of 10 years.

The Upper Grand River basin lies within the Dissected Till Plains physiographic province. The land is a mixture of hills and plains. Fifty-three percent of the land is pasture and hayfields, 33 percent is row crop and 14 percent forest.

Except for limited areas where streams may have incised Pennsylvanian aged rock, the surface of the basin is glacial till overlain by loess. Glacial till is a mostly unsorted mixture of clay, sand, gravel and rock debris created and pushed southward into Missouri by the great glacial ice sheets. Loess is a windblown silt deposit. Depth of the till is

highly variable but is generally less than 200 feet. Loess deposits are generally 10-20 feet in depth. Cyclical (repetitive) deposits of sandstone, siltstone, shale, limestone and coal of Pennsylvanian age underlie these glacial deposits.

The presence of the clayey till and the underlying shale and coal beds insure that there is very little movement of water to the subsurface. Most water movement in the basin is through the surface stream network. Water that reaches the subsurface will resurface locally when a stream valley incises a confining aquatard (an impermeable layer). There are 19 small springs of note in basin, and only one, R. C. Price Spring produces more than 10 gallons per minute of flow. None of these springs is believed to sustain flow during dry weather. Since very little water infiltrates to the subsurface, streamflow can be very high during wet weather. For the same reason, base flows, streamflow sustained only by the re-emergence of groundwater into the stream, are very low during the intervening dry periods.

Water Quality Concerns

Acceptable water quality is defined by Missouri's Water Quality Standards [<http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf>] . Streams or lakes that do not meet these standards are considered "impaired". They may not be fit for certain uses such as swimming, drinking water supply or protection of fish and other aquatic life. Waters are considered to be "affected" rather than "impaired" if water quality changes are less serious and state standards are not exceeded. These standards also list more than 3,600 classified streams and more than 400 classified lakes in the state. A classified stream is one that is either a permanently flowing stream or one that may stop flowing in dry weather but still maintains large pools of water that support aquatic life. Unclassified streams are small tributaries to classified streams. They typically have flowing water only during wet weather and are dry for the remainder of the year.

Water Quality in Prairie Streams

<http://www.dnr.mo.gov/env/wpp/watersheds/info/wq-prairie-str.pdf>

Aquatic Habitat in Prairie Streams

<http://www.dnr.mo.gov/env/wpp/watersheds/info/aquatic-hab-prairie-str.pdf>

Point Source Pollution

Point source pollution is a discharge of wastewater from a single location such as a wastewater treatment plant. Wastewater treatment plants can serve industries, small businesses, subdivisions, mobile home parks, apartment complexes, or entire cities. Wastewater from residential sources such as subdivisions, apartments and mobile home parks is often referred to as "domestic wastewater." It primarily contains treated human wastes, food wastes and detergents. The primary pollutants of concern in domestic wastewater are the amount of organic matter, which is commonly reported as Biological Oxygen Demand (BOD), suspended solids, and ammonia. Industrial and commercial

wastewater can be more complex and may contain, in addition to domestic wastes, heavy metals or man-made organic chemicals that can be potentially toxic. Discharges from most municipal wastewater treatment plants are usually a mixture of domestic and industrial/commercial wastewater. Most wastewater plant discharges are also typically high in nitrogen and phosphorus, two elements that act as fertilizers and can cause excessive algae growth in waters receiving these discharges.

There are 39 permitted domestic or industrial/commercial point sources that discharge a combined 4.77 million gallons per day (mgd) of treated wastewater into the waters of the Upper Grand River basin. The largest are the 3.0-mgd wastewater discharge from the City of Chillicothe and the 1.6-mgd discharge from the City of Cameron. There are 859 miles of classified streams in the basin. Five miles (less than one percent) are known to be affected or impaired by point source wastewater discharges. There are also 4.9 miles of unclassified streams that are affected or impaired by point source wastewater discharges. Discharges that affect or impair at least 0.5 miles of stream includes these municipal wastewater treatment plants: Bethany, Albany, Hamilton NE, Gallatin and Grant City West.

Wastewater Treatment

<http://www.dnr.mo.gov/env/wpp/watersheds/info/wastewater-treatment.pdf>

Nonpoint Source Pollution

Nonpoint source pollution occurs when pollutants enter bodies of water at points that are not well-defined and stable. Examples include the erosion of sediments or the entrance of polluted surface runoff or groundwater into lakes and streams. Locations of nonpoint source pollution are often widely dispersed and are difficult to identify or control. In the upper Grand River basin, the most serious nonpoint problem is degradation of aquatic habitat. A total of 859 miles (100 percent) of classified streams in the basin are considered to have degraded aquatic habitat. The lack of infiltration of rainfall, when combined with local soil tillage and other land uses leads to a large amount of surface runoff during wet weather. This contributes to soil erosion and high levels of sediment deposition in streams. The quality of aquatic habitat is further impaired by removal of wooded riparian vegetation, and by the channelization, or straightening, of streams. Channelization has occurred in 138 miles (16 percent) of streams in the basin.

Storm water runoff in the Midwest can carry significant amounts of fertilizers, animal wastes, and pesticides into streams. Proper animal waste management is especially important in this basin due to the presence of several large hog farms that land apply large amounts of liquid hog manure.

Atrazine is an agricultural herbicide used on corn and grain sorghum that is commonly found in stormwater. Missouri's water quality standards allow no more than 3.0 ug/l Atrazine in drinking water reservoirs as a long-term average. There are 18 reservoirs in the Upper Grand River basin that serve as drinking water supplies. Eleven of these

reservoirs have had sufficient monitoring of Atrazine to establish long term averages in the lake water prior to treatment. This information is shown in Table 2. The state standard for the maximum allowable level of Atrazine in a raw public water supply is 3 ug/l as an average. None of the lakes monitored for Atrazine exceed this standard.

Table 2. Long Term Average Atrazine Levels in Reservoirs of the Upper Grand River Basin (ug/l).

Reservoir	Average Raw Water Atrazine (ug/l)
Grindstone	2.05
Jamesport Community	0.93
Jamesport City	1.32
Cameron No. 3	1.67
Maysville	1.19
Hamilton	0.46
Bethany No.2 (New)	0.28
Eagleville	0.25
Breckenridge	0.19

Finished drinking water is monitored regularly at all public supplies. Finished drinking water in Missouri has been found to meet state standards for pesticides. Levels of Atrazine in finished drinking water supplies may be significantly lower than the amounts found in the reservoirs if the drinking water plants take measures to reduce Atrazine during the water treatment process.

Drinking water reservoirs throughout northern and western Missouri are also monitored for several other common agricultural herbicides. Results of this monitoring over many years indicates that the only other herbicide that may be a human health concern in drinking water reservoirs is Cyanazine. Cyanazine has not been a problem in any of the eleven reservoirs monitored in the Upper Grand River basin. Federal regulations require the end of all Cyanazine use in 2002.

Groundwater can also be affected by nonpoint source pollution. In northern and western Missouri, some public water supplies and many private water supplies come from groundwater. While public groundwater supplies are routinely tested and protected, many private wells are not. Studies of water quality of private wells in northern and western Missouri show that about one third of wells exceed the drinking water standard for nitrate. About 2 percent exceed drinking water standards for pesticides. This

contamination is often caused by local land use practices or surface contamination of the wellhead and does not represent widespread contamination of the underground aquifer. Deeper aquifers are protected from surface contamination by impermeable strata.

During warm weather when stream flows are low, livestock tend to gather in and around streams. The wastes they leave in the water contribute to nuisance algae growths, low levels of dissolved oxygen and elevated levels of ammonia and bacteria.

Water Quality Management

The department achieves water quality management of point source pollutants through the issuance and enforcement of wastewater discharge permits. These permits limit the amount of pollutants that can be discharged. All point source wastewater dischargers must obtain a permit and adhere to its discharge limitations. All permits require at least a level of treatment equal to national wastewater treatment standards. In situations where these national treatment standards are not adequate to protect the streams or lakes receiving these wastewater discharges, stricter permit limits that do protect these waters are required. The permits require regular monitoring and reporting of discharge quality. The department also conducts regular inspection of wastewater treatment facilities and receiving waters.

Nonpoint source pollution is addressed through the state's nonpoint source management plan. This plan is a cooperative program between the Department of Natural Resources and other federal, state and local government agencies or organizations, local landowners and other interested citizens. The plan emphasizes addressing problems at the watershed level through the use of management practices that control nonpoint pollution. The most commonly supported practices are those that control soil erosion on agricultural and urban lands, improve quality and quantity of forage on grazing lands, protect riparian zones, and those that control runoff of animal manures, fertilizers and pesticides. The state nonpoint source management plan is a voluntary program that provides funds to help defray the cost of adopting management practices.

Since 1990, there have been 20 nonpoint source watershed projects in the basin. Eighteen of these have been funded by state sales tax money earmarked for soil and water conservation. Two projects were funded primarily through federal Clean Water Act funds. These projects treated over 68,000 acres of land, comprising about 4 percent of the entire basin.

Table 3. Nonpoint Source Watershed Projects in the Upper Grand River Basin

Watershed Name	County	Project Date	Watershed Size (Acres)	Acres Treated	Percent of Watershed Treated
Linn Cr.	Gentry	1990-94	4,300	2,676	62
Marlowe Cr.	Worth	1990-94	7,877	2,964	38

Lick Fork	Caldwell Daviess	1992-96	5,700	2,188	38
Cypress Cr.	Harrison	1992-96	11,600	3,593	31
Bear Branch	Daviess	1993-97	3,865	1,364	35
Walnut Fork	Gentry	1993-97	11,000	3,486	32
Long Branch	Gentry	1993-97	9,000	2,483	28
Big Rock Cr.	Worth	1993-97	8,770	1,294	15
Lower Marlowe Cr.	Harrison	1994-98	8,024	1,263	16
Little Otter Cr.	Caldwell	1995-99	5,585	1,797	32
Upper White Oak Cr.	Harrison	1995-99	12,165	304	2
Honey,Dog,Marrowbone Cr.	Daviess	1992-99	61,800	22,907	37
Big Muddy Cr.	Daviess	1994-99	75,616	21,392	28
Hamilton Reservoir	Caldwell	1995-99			
Jamesport Reservoir	Daviess	1995-99			
Cameron Reservoir Wtrshed	DeKalb	1998-05			
Mudd Creek	Caldwell	2003-10			
Hickory Cr.	Daviess	2003-09			
W. Fork Big Cr.	Harrison	2003-10			
Shoal Creek	Caldwell	2005-12			

The Missouri Department of Natural Resources monitors water chemistry and aquatic invertebrate communities at many locations in Missouri. The department also tracks the quality of domestic, industrial and storm water discharges. These monitoring activities provide information on water quality problems, such as their specific location, pollutants, sources and possible solutions. This information guides the management activities the department takes to protect water quality in Missouri.

Web links

US Geological Survey

<http://mo.water.usgs.gov/>

Kansas City District Corps of Engineers

<http://www.nwk.usace.army.mil/>

Missouri Department of Conservation

<http://www.mdc.mo.gov/fish/watershed/grand/140cotxt.htm>

US Environmental Protection Agency

<http://www.epa.gov/region7/water/index.htm>